Protecting Salmon: Highlights

Endangered Species Act
Federal Columbia River Power System
2004 Progress Report

Beginning in 2001, the Action Agencies have reported their annual progress in implementing the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) biological opinions for the operation and maintenance of the Federal Columbia River Power System (FCRPS). These biological opinions were issued in December 2000. Progress reports for 2001, 2002 and 2003 are available at *www.salmonrecovery.gov/implementation.shtml*.

In November 2004, NOAA Fisheries issued the *Revised 2004 Biological Opinion on the Operation of the Federal Columbia River Power System and 19 Bureau of Reclamation Projects* (2004 BiOp). The 2004 BiOp considered the Action Agencies' *Final Updated Proposed Action for the FCRPS Biological Opinion Remand* (UPA). In the UPA, the Action Agencies committed to continue implementing most of the actions from the 2000 BiOp, with the addition of several new actions, such as reduced fish transportation, habitat protection in certain upper Columbia subbasins, and expanded control of predators that consume young salmon.

All of these actions, old and new, focus on achieving biological performance standards or programmatic performance targets, or address factors that limit certain life stages for specific evolutionarily significant units (ESUs). Most of the actions highlighted in this report were initiated under the 2000 BiOp and are continuing with some improvements under the 2004 BiOp and the UPA.

Thirteen stocks of Columbia Basin salmon and steelhead are listed as threatened or endangered under the Endangered Species Act (ESA). Step by step, the Pacific Northwest continues to make progress on protecting and restoring these fish. Improvements in habitat, hatcheries, harvest management and hydrosystem operations are adding up to give fish the kind of habitat they need to spawn and grow, as well as a safer path for migrating to and from the ocean.

The federal agencies that manage the system of dams in the basin include the U.S. Army Corps of Engineers (Corps), the Bureau of Reclamation (Reclamation), and the Bonneville Power Administration (BPA), collectively known as the Action Agencies. They consult with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) on how they will operate those dams to protect fish. Operating the dams for flood control, power production, irrigation, navigation and other uses affects the flow of the river and water conditions. The dams also impede these fish as they migrate many miles to the ocean to mature and return upriver to spawn in inland streams and tributaries.

It has been said that there is no silver bullet to recover species with such complex life cycles—birthing and dying in freshwater rivers but spending most of their lives in the ocean—and that have been assaulted by multiple influences. These influences include the obvious, hydro development and operations, but also such things as encroaching development, harvest, agrarian and forestry practices, predation, weather cycles and the still largely mysterious ocean conditions.

Given this, the effort to protect and rebuild threatened and endangered species has been built on a carefully coordinated set of measures that addresses all of these effects and builds step by step on the progress of each component. This report highlights some of the significant actions implemented by the Action Agencies in 2004 to protect ESA-listed salmon and steelhead affected by the operation and maintenance of the Federal Columbia River Power System (FCRPS).

Although this report focuses on efforts of the Action Agencies, others in the region are making significant contributions to improve the quality of salmon habitat, increase knowledge about salmon and steelhead life cycles and requirements, and prioritize conservation and recovery. Progress reports of other efforts are available on the Web (see page 16). The Action Agencies remain committed to continued collaboration and coordination with other regional parties working toward the common goal of recovery of Pacific salmon and steelhead populations.

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2004 Conditions and Accomplishments

Adult Fish Returns

One way the region tracks how well salmon and steelhead are doing is by counting the number of adult fish that return each year to spawn. Many dams have fish counting stations where accurate tallies can be made of the various species that climb the fish ladders and pass the counting windows. Although the number of returning adult fish does not approach the estimated historical averages, returns were impressive in 2004 and continued the increasing abundance trends of 2001, 2002 and 2003 (Fig. 1).

Fish Survival

Another benchmark of progress made by the Action Agencies is adult and juvenile survival through the hydrosystem. The Action Agencies have more direct influence on this outcome than on the broader, non-hydrosystem goals.

Adult fish swim up fish ladders that are built into the dams. These ladders work well and adult fish survival through the system of dams is now roughly equivalent to what could be expected in an undammed natural river. As a result, performance standards for adult fish survival through the hydrosystem were met or exceeded in 2004.

The percentage of young fish that safely pass the dams to continue their in-river migration to the ocean has increased notably over the past several decades. NOAA Fisheries research on Snake River spring/summer Chinook indicates that between 50 and 60 percent of juvenile fish that migrate in-river now successfully pass the eight Corps dams during most flow years. This survival is comparable to when there were only four Corps dams in the lower Columbia River and is up from about ten to 40 percent from the 1960s and 1970s.

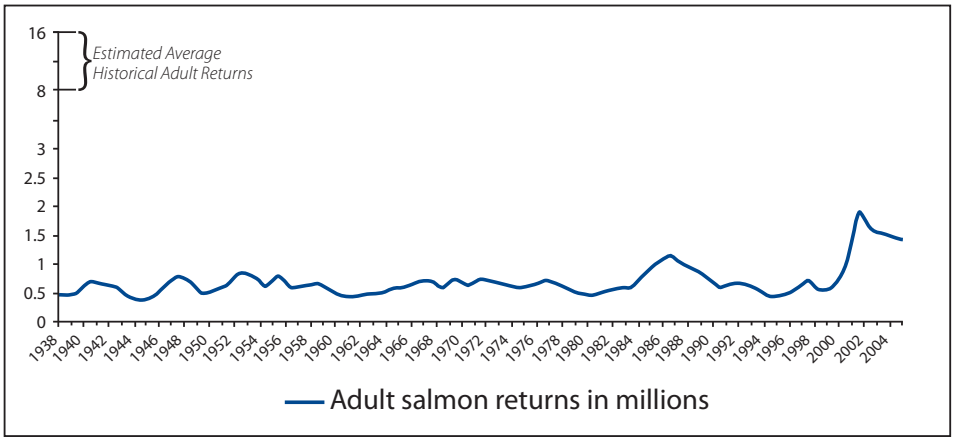
The Columbia Basin experienced drier than normal conditions in 2004 and the survival percentages for juvenile fish that migrated in-river reflects this. Survival for yearling Chinook (includes spring and summer Chinook) juveniles migrating in-river during 2004 from the Lower Granite Dam tailrace (the area below the dam) to the Bonneville Dam tailrace was 39.5 percent. This was lower than 2002 (57.8 percent) and 2003 (53.2 percent) but higher than 2001, which was a very dry year (27.9 percent). It was also lower than the performance standard of 49.6 percent in the established biological opinion.

In-river survival data for Snake River steelhead migrants was available only for the stretch of river from Lower Granite to John Day Dam, due to problems with detection at Bonneville Dam. As with the Chinook, the estimated survival in 2004 was lower than in 2002 and 2003, but higher than in 2001. In-river survival from Lower Granite to Bonneville Dam was approximately 26 percent and 31 percent for 2002 and 2003, respectively, and 4 percent in 2001. Steelhead survival in the reach from Lower Monumental Dam to McNary Dam was again particularly low, likely due to predation by Caspian tern colonies above McNary Dam. Estimates of tern-related steelhead mortality suggest approximately 35 percent loss in 2004.

For upper Columbia River spring and summer Chinook, survival from McNary Dam to Bonneville Dam was 62.2 percent, down from 2002 (74.5 percent) and 2003 (76.7 percent). Steelhead survival was also down, from 69.5 percent in 2003 to 49.6 percent in 2004. This fell short of the biological opinion performance standard of 67.6 percent survival.

To help address the added hazards of in-river migration that juvenile fish face in a dry year such as 2004, the biological opinion provides for maximizing the transport of juvenile fish to lessen the impact of low water and high temperatures. The fish transport program is discussed more fully on page 5.

Fig. 1. Adult Salmon/Steelhead Returns at Bonneville Dam, 1938 to 2004



Columbia River Basin

Hydrosystem

Improvements at the Dams

Most salmon and steelhead in the Columbia River Basin encounter one or more hydroelectric dams as they migrate to and from the ocean. Fish passage systems provide various routes to help salmon and steelhead get past the dams. In 2004, the agencies continued to make improvements to fish passage. Most improvements for adult fish passage were completed in prior years, but many more improvements were made for juvenile fish passage. Highlights of some of the more significant fish passage improvements made in 2004 are noted below.

SPILL FOR FISH

Spill is widely recognized as one of the safest means of juvenile fish passage. Water is spilled through spillway openings rather than being routed through turbines to generate power or being used for other purposes. Water and fish rush through the spillway and into the river below the dam. The biological opinion calls for spring and summer spill for juvenile salmon and steelhead passage at the Corps' lower Columbia and Snake River dams. Spill is managed carefully to avoid gas supersaturation that can be harmful to fish (see 2004 Water Conditions and Operations section of this report).

In 2004, spring and summer spill was provided according to the Water Management Plan adopted by the agencies that year. The Corps initiated spill at the lower Snake River dams in early April but stopped later in the month when the water supply deteriorated. When flows in the Snake River are too low, the biological opinion allows spill to be stopped so the maximum numbers of fish can be collected for barge transport.

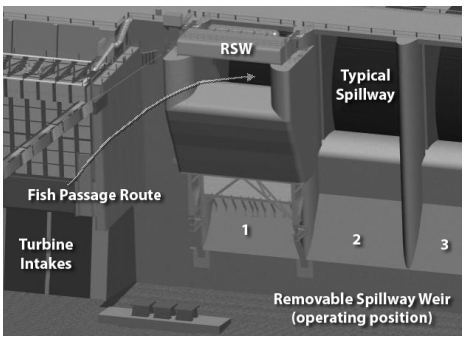


Fig. 2 ***Removable spillway weirs or other surface-oriented passage systems are planned for all eight lower Columbia and Snake River dams.***

SURFACE PASSAGE SYSTEMS

Most juvenile salmon tend to stay in the upper 10 to 20 feet of the water column as they migrate downstream to the ocean. When approaching the dams, juvenile fish need to dive to depths of 50 to 60 feet to find passage routes such as a spillway opening or a juvenile bypass channel. For several years, engineers and biologists have been pursuing new technologies that would provide more surface-oriented, less stressful passage routes for juvenile fish. Surface passage can also enhance spill-based passage. It has the potential to improve juvenile fish survival, save money, and improve water quality.

One of the new surface passage technologies is a removable spillway weir (RSW), or fish slide, that fits inside a dam spillway and allows juvenile fish to pass near the water surface under lower accelerations and lower pressures (Fig. 2). As water is spilled through the weir, juvenile salmon and steelhead are carried over a raised spillway crest, similar to a waterslide. Tests in 2002 and 2003 of a prototype installed at Lower Granite Dam on the Snake River have demonstrated the value of this type of improvement for fish passage. Juvenile salmon and steelhead that used the slide survived at similar rates to those using a conventional spillway—about 98 percent survival—and had reduced delay above the dam so that they were less susceptible to predators. While the slide attracted about the same number of fish, only about one-fifth as much water was spilled. A fish slide was constructed for the Ice Harbor Dam in 2004 and installed in early 2005.

At Bonneville Dam on the lower Columbia River, construction was completed on a corner collector, another type of surface passage system. Tests in 2004 indicated a survival rate of nearly 100 percent for spring Chinook salmon through the corner collector, and about a 95 percent survival rate through all passage routes combined at this dam. At The Dalles Dam, a spill wall was completed, designed to move juvenile fish more quickly and safely downstream once they passed through the spillways. Biologists are monitoring and gathering data on its success.

JUVENILE BYPASS SYSTEMS

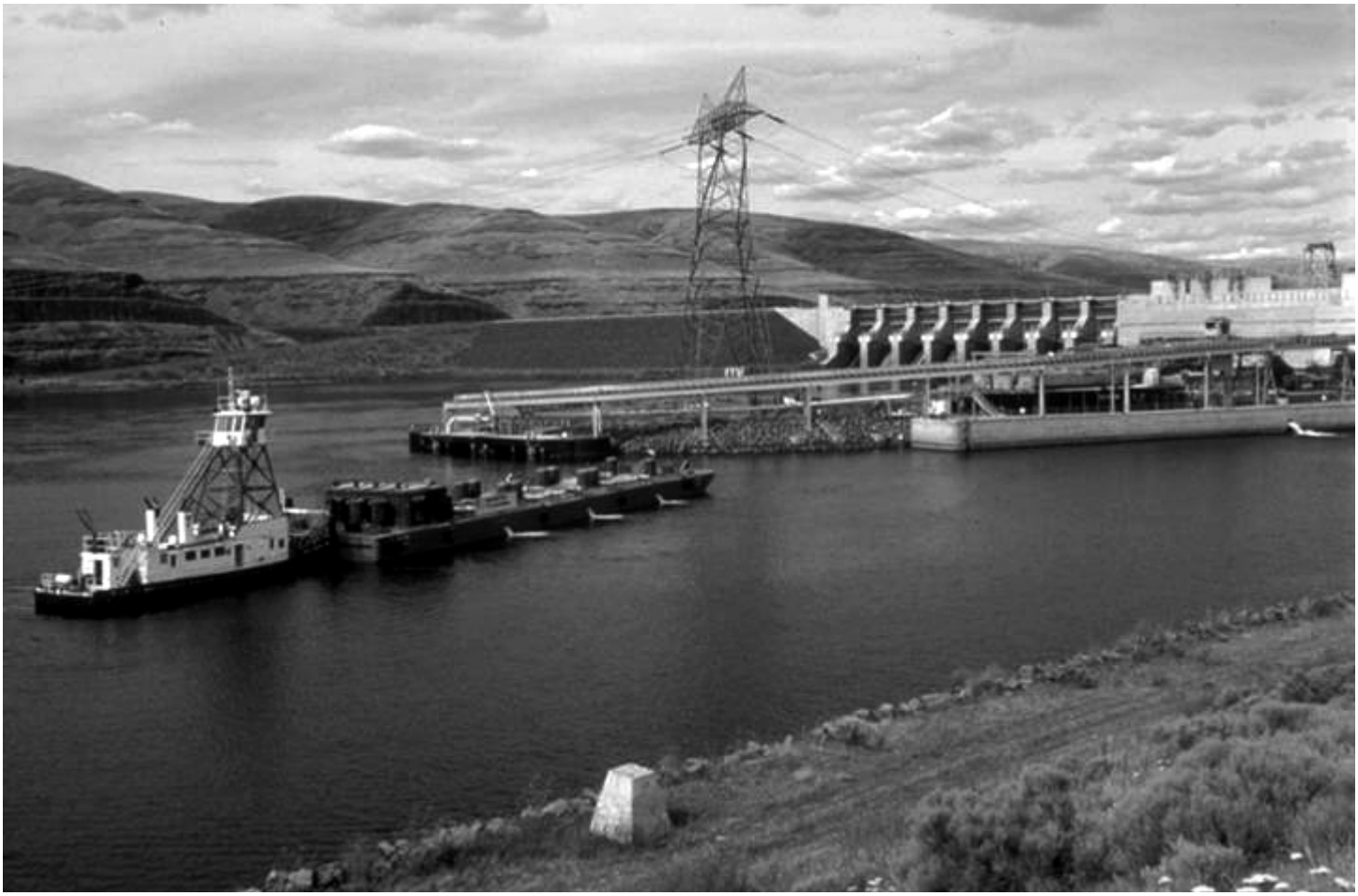
Juvenile fish bypass systems at the dams guide fish away from turbines by means of submerged screens installed in front of the turbines. As the fish migrate downriver, they follow currents and may be attracted by the current created by an operating turbine. As the fish follow the current down toward the turbines, the screens guide fish back up to bypass channels in the dam. These fish are then either routed back out to the river below the dam, which is called "bypassing" or, at the four dams with fish transport facilities, they may be loaded into barges or trucks for transport.

For several decades, juvenile bypass systems have been in operation at seven of

2004 Effort to Modify Spill

As part of an effort to move to more cost-effective operations, the BPA and Corps discussed a proposal with NOAA Fisheries and other regional agencies to reduce spill for fish in summer 2004. The idea of reducing summer spill was more cost effectiveness while maintaining biological objectives. When water is spilled it does not produce power, and BPA considers summer spill particularly expensive in terms of foregone revenues for the corresponding increase in number of returning adult fish.

The agencies analyzed a number of alternative summer spill scenarios ranging from the full amount to zero spill in July and August, and a range of offset actions to make up for fish that may have been lost due to decreased spill. After months of analysis with input from States, tribes and other regional parties, the agencies decided to modify summer spill to end fish passage spill at Bonneville and The Dalles dams August 1, and at Ice Harbor and John Day dams August 26, with actions to offset potential adverse impacts to salmon and steelhead. However, the plan was successfully challenged in court and was not implemented.



As part of a spread-the-risk approach, juvenile fish that enter the bypass system at some dams may be transported downriver in specially designed barges and trucks.

the eight lower Columbia and Snake River dams. At John Day Dam, engineers completed tests of prototype extended-length guidance screens designed to increase the percentage of juvenile fish that are guided into the bypass system. Installation is pending. Most of the other dams already use the extended screens.

FISH TRANSPORTATION/BARGING

The Corps has operated a juvenile fish transportation program since the 1970s. Juvenile salmon and steelhead that go through the juvenile bypass systems at four of the lower Snake and Columbia River dams can be collected and placed in specially designed barges and trucks for transport past the remaining dams.

In 2004, the Corps collected over 23 million juvenile salmon at Lower Granite, Little Goose, Lower Monumental, and McNary dams and barged or trucked them to a release point below Bonneville Dam. The survival rate for fish that are transported past the dams is about 98 percent, although research continues to determine if there are delayed effects to the fish once they are released back into the river downstream of Bonneville Dam and if these effects can be minimized.

TAGGING FISH FOR RESEARCH

Fish research is aided by the use of Passive Integrated Transponder, or PIT tags, that are inserted into juvenile fish and read as the fish pass detectors at the dams. As the tag is read, data about that particular fish is fed into computers. The migration of PIT-tagged fish can be tracked through the river system.

In 2004, improvements were made to devices for detecting adult fish as they pass through fish ladders. These PIT-tag detectors enable researchers to track the progress of individual fish through the dams from the juvenile migration, and again through the adult migration. Adult PIT-tag detectors are in operation at Bonneville, McNary, Ice Harbor and Lower Granite dams. The Corps and BPA tested a PIT-tag detection system for the Bonneville Dam Second Powerhouse Corner Collector in 2004. Although this system failed, it provided important information so the agencies could go forward with a final design for a system scheduled to be installed in 2005.

2004 WATER CONDITIONS AND OPERATIONS

In addition to fish passage at the dams, storage reservoirs are operated to enhance fish survival. River flows are augmented with water released from upstream dams to help juvenile migration and adult spawning, as well as to cool water temperatures in the summer. An in-season management team, the Technical Management Team (TMT), representing federal agencies, states and tribes, meets year round to monitor fish migrations and stream flow forecasts and to shape operations for fish. The TMT may meet as often as weekly during the active juvenile fish migration period from April through August. This team also invites input from interested parties.

Survey stakes mark chum redds at Ives Island below Bonneville Dam. The highest elevations determine the minimum level for water flows needed to keep the redds watered until April when the young chum emerge.

The Columbia and Snake Rivers have limited reservoir storage compared with other major river systems, such as the Colorado. As a result, the Columbia could almost be considered run of the river. Storage can be managed to make modest adjustments in river flows for fish, but cannot convert a dry year into a much better one or save a huge runoff from a wet year for future dry years. This means that due to natural flows, flow objectives for juvenile fish cannot be physically achieved under many conditions or at many times of the year. However, the river operators provide as much flow as possible for fish needs. The actual flows were all within an expected range that would likely occur under the low flow conditions of 2004 (Fig. 3). Specific operating rules are used at individual reservoirs to provide salmon flows, protect resident fish, and control floods.

The natural water supply in the Columbia and Snake Rivers was below average in 2004. Although spring and summer flow objectives were not met due to the below-average water supply, flows were provided to the extent water was available. All operating guidelines for salmon flows were followed.

As in past years, water flows were provided in 2004 to support spawning chum salmon below Bonneville Dam. Water levels need to be at a level sufficient to keep chum redds (egg nests) watered so that the eggs remain viable.

WATER QUALITY

The Action Agencies continued to monitor water quality to measure temperature and dissolved gas in the river. When providing spill for fish passage, dam operators direct water through the spillways instead of through the turbines. At these large dams, spilled water plunges to the river below the dam with enough force to supersaturate atmospheric gases in the water. These gases can build up to levels that are dangerous to salmon and other aquatic life. To avoid this, the agencies monitor levels of total dissolved gas, or TDG, in the river and adjust patterns and quantities of spill to stay within allowable levels. In 2004, they were able to meet the state TDG criteria 97.6 percent of the time.

To help cool the lower Snake River temperatures in the summer, cold water was released from Dworshak Dam on the Clearwater River from early July through mid-September. The benefit of these cold-water releases was apparent as the agencies monitored temperatures in the Snake River below, at Lower Granite Dam. Temperatures there were within state standards for all but about 10 hours of the entire season.

For a more thorough discussion of how the system was operated in 2004, the TMT end of year review is available at *www.nwd-wc.usace.army.mil/tmt/agendas/2004/1110min.pdf.*

Fig. 3. 2004 Seasonal Flow Objectives and Actual Flows, in thousand feet per second (kcfs)

	McNary	Lower Granite	Priest Rapids
Spring			
Objective	220	85	135
Actual	203	70	122
Summer			
Objective	200	50	N/A
Actual	134	33	N/A

Predator Control Actions

Some birds and fish consume large numbers of juvenile salmon and are a major cause of mortality of ESA-listed fish. In 2004, the Action Agencies increased their efforts to control specific predators and improve survival of juvenile fish beyond the requirements of the 2000 BiOp.

CASPIAN TERNS AND CORMORANTS

The program to redistribute Caspian terns from Rice Island, upriver in the Columbia River Estuary, to East Sand Island nearer to the ocean yielded continued good results in 2004. The intent of the redistribution is to shift the terns' diets away from mostly salmon and toward a wider variety of fish. The Rice Island diet resulted in tern consumption of 15 million salmonids in 1999. By 2004, after the birds had moved to East Sand Island, that number fell to three million. A Tern Management Final Environmental Impact Statement jointly prepared by several agencies recommends that two-thirds of the Caspian terns be further redistributed in alternate sites in Washington, Oregon and California (*www.nwp.usace.army.mil/pm/e/en_plan_avian.asp*).

The agencies are now considering management actions to address a new challenge: the estuary population of double-crested cormorants is increasing, from around 100 birds in 1989 to possibly 18,000 in 2004. The birds consumed an estimated 6.4 million salmonids in 2004.

A relatively small but stable population of Caspian terns (about 1,000 birds) on Crescent Island above McNary Dam consumed an estimated one million smolts in 2004, including about 35 percent of the Snake River steelhead smolts. The agencies will also evaluate alternatives to address this situation.

SEA LIONS AT BONNEVILLE DAM

Male sea lions follow migrating adult salmon up the Columbia River in the spring. The sea lions usually depart in late May for the San Miguel Islands in southern California, where the females are waiting. Large numbers of sea lions were first seen at Bonneville Dam in 2002 when 30 were counted. Biologists have been gathering data on sea lions at the dam since then. In 2003, 106 sea lions were counted, and in 2004, 101. Not all of these were at the dam at the same time; usually about 30 are present on any one day. In 2004, a sea lion was seen in one of the fish ladders and in 2005, sea lions traveled as far as the viewing windows at both visitor centers at Bonneville Dam. Sea lions consumed about 0.3 percent of the spring migrating fish in 2002, 1.1 percent in 2003, and 2.1 percent in 2004. The Corps is working with NOAA Fisheries and other agencies to find a way to keep sea lions away from the fish ladders so adult fish can continue their journey up the Columbia River to spawn.

After a large Caspian tern colony was persuaded to relocate to East Sand Island from Rice Island in the Columbia River Estuary, its salmon and steelhead consumption fell to three million fish in 2004, from a 1999 high of 15 million.

After its capture, a large northern pikeminnow regurgitates its diet of young salmon. A Columbia River angler received a reward from the NPMP for the capture of this fish. In 2004, more than 267,000 northern pikeminow were removed from the Columbia River.

NORTHERN PIKEMINNOW

Northern pikeminnow are voracious consumers of juvenile salmon. Since 1990 BPA has funded the Northern Pikeminnow Management Program (NPMP) to reduce the numbers of larger pikeminnow and improve survival of juvenile salmon. In 2004, BPA increased the reward for the catch of this predator and increased the number removed by 25 percent from prior years. This increased reward was made permanent to sustain the higher catches. Since its inception the NPMP has removed over 2.5 million northern pikeminnow from the Columbia River.

Accomplishments to Date

What are our goals and strategies?	What are our key initiatives?	What have we accomplished?
HYDROSYSTEM		
Increase the survival rates of fish passing through mainstem dams: • Configure dam facilities to improve juvenile and adult fish passage survival • Manage water to improve juvenile and adult fish survival • Operate and maintain fish passage facilities to improve fish survival	• Operate and maintain adult fish ladders and other fish facilities • Guide juvenile fish away from turbines • Improve passage routes through the dams for juvenile fish • Manage available water to improve conditions for migrating fish • Transport juvenile fish in trucks or barges past dams in a "spread-the-risk approach" • Track migrating fish with Passive Integrated Transponder (PIT) detection systems	• Contributing to increasing trends of adult fish returns and abundance • Adult fish survival through the system of dams is now similar to that of a natural river • Juvenile survival through the hydrosystem is improved with bypass systems, surface passage systems, and spill • Based on available water supply, water releases are supporting seasonal fish migrations • Transporting juvenile fish in trucks or barges around dams when this provides better survival than migrating in-river • More accurate monitoring of fish migration with improved fish detection systems
PREDATOR CONTROL		
Reduce the number of juvenile fish consumed by predators: • Redistribute avian predators • Reduce fish predation	• Redistribute Caspian terns from Rice Island to East Sand Island • Provide incentives to reduce the number of large northern pikeminnow in the Columbia River	• Fewer juvenile salmon are consumed by Caspian terns (from 15 million in 1999 to 3 million in 2004) • Since 2000, removed over 2.5 million northern pikeminnow from the Columbia River through the Northern Pikeminnow Management Program • In 2004, the number of larger northern pikeminnow removed was increased by 25 percent; the higher reward structure will continue to sustain this increase in future years
HATCHERIES		
Use hatcheries to address biological priorities of salmon: • Implement safety-net programs to avoid extinction • Reduce potentially harmful effects of artificial production	• Intervene with artificial production techniques to reduce the risk of extinction of high risk fish populations • Modify hatchery practices or facilities if needed	• Safety-net hatchery programs reduced extinction risk for populations of Snake River sockeye, spring/summer Chinook and mid- and lower Columbia steelhead • Hatchery Genetic Management Plans prepared for NOAA Fisheries review; may be used to identify and prioritize facilities and practices needing modification

Accomplishments to Date

What are our goals and strategies?	What are our key initiatives?	What have we accomplished?
HABITAT		
Improve tributary and/or estuary habitat used by salmon for spawning or rearing: • Protect and improve tributary habitat • Protect and improve estuary habitat	• Increase water quantity in tributary streams • Install or retrofit fish screens at tributary water diversions • Remove fish passage barriers and increase access to tributary habitat • Protect and enhance tributary riparian habitat • Protect, enhance, restore, and create habitat in the estuary	• Purchased, leased, or conserved over 365 cfs of water in tributaries; almost 90 cfs in 2004 alone • Fish screens installed or retrofitted at more than 70 water diversions • Restored access for fish to more than 1,100 miles of tributary habitat; more than 250 miles restored in 2004 • Almost 1,000 miles of tributary riparian habitat protected or enhanced; over 280 miles added in 2004 • 451 acres of estuary habitat acquired at Crims Island; restoring 76 acres of tidal marsh and 115 acres of forest • In 2004, acquired 155 acres along Germany Creek and began restoration of over 135 acres at three locations in the estuary
RESEARCH, MONITORING AND EVALUATION		
Assess and maximize performance of actions: • Monitor status of salmon • Assess the effects of actions on salmon • Address and resolve areas of uncertainty	• Monitor status of fish within the hydrosystem corridor • Contribute information for use in a regionally developed network of monitoring and assessment programs • Integrate status monitoring with action effectiveness and critical uncertainty research strategies • Implement pilot studies to determine success or effectiveness of actions to improve fish survival • Coordinate with regional RM&E efforts to maximize the amount and quality of data given limited resources	• Monitoring juvenile and adult fish passing through the system of Columbia and Snake River dams • Improved accuracy of counting fish through the hydrosystem • Conducting studies to determine and confirm the benefits of actions implemented in the hydrosystem, tributaries and estuary • Evaluating the survival and adult return rates of transported juvenile salmon compared to fish that migrate in the river • Monitoring and evaluating juvenile salmon use of the estuary and ocean plume • Implementing studies to determine the spawning effectiveness of hatchery fish • Funded development of a comprehensive marking strategy to improve monitoring of hatchery-origin fish and assess status of wild fish in natural spawning areas

Hatchery Actions

The Action Agencies continued to fund safety-net programs to reduce the extinction risk of at-risk populations of Snake River sockeye, spring/summer Chinook and mid- and lower Columbia steelhead.

The Snake River Sockeye Salmon Captive Broodstock Program is one of those safety net programs. Snake River sockeye salmon (*Oncorhynchus nerka*) are a prime example of a species on the threshold of extinction, with the last known remnants of this stock returning to Redfish Lake, Idaho. On the basis a of critically low population and a listing under ESA, a captive broodstock program was implemented by federal, state and tribal partners as an emergency measure to preserve Redfish Lake sockeye salmon. During the 1990s, 16 wild fish returned to Redfish Lake (zero to eight per year); all were captured for the broodstock program.

Under the program, hundreds of thousands of progeny (prespawning adults, eyed eggs, presmolts and smolts) have been raised in carefully managed hatcheries and replanted into habitats. These progeny are contributing to the increased population size of this imperiled fish. Between 1999 and 2004, about 340 adults returned to Redfish Lake from captive broodstock releases—an increase of over 20 times the number of wild fish that returned in the 1990s. The program maintains important lineages of Redfish Lake sockeye salmon, preserves genetic variability and ensures that greater numbers of Redfish Lake sockeye with diverse demographics are available for release in

These anadromous adult sockeye salmon are waiting to be released to spawn in Redfish Lake. These fish were intercepted after their return from the ocean in 2000, when 257 adults made it back to Redfish Lake. That was the highest return in 25 years for this species of sockeye salmon.

Boxes containing eggs raised under the Snake River sockeye captive broodstock program are planted in Redfish Lake.

appropriate habitats. It is virtually certain that the broodstock program has, at least for the short term, prevented extinction of Redfish Lake sockeye salmon.

The Action Agencies also funded development of Hatchery Genetic Management Plans (HGMPs) to identify hatchery reform actions that would reduce the negative impacts of hatchery operations on ESA-listed stocks. Most of the HGMPs have been prepared and were submitted to NOAA Fisheries for review. Upon NOAA Fisheries' approval or revision, HGMPs will be considered complete. As part of the ESU-wide evaluation, NOAA Fisheries has indicated it will include a prioritized list of actions specific to individual hatchery programs to be considered for implementation or funding. These prioritized lists are expected to include actions that would contribute to the recovery of listed stocks.

Habitat Protection & Improvement Actions

The Action Agencies' salmon protection efforts go well beyond those implemented in the mainstem Columbia River or at specific dams. Recognizing that the Columbia River estuary and tributaries provide important habitats to salmon during their various life stages, the Action Agencies, in coordination with other federal, state, and local partners, are steadily implementing actions that promote functional improvements in those aquatic ecosystems. The Action Agencies are increasing water quantity in streams, installing or retrofitting fish screens at water diversions, removing barriers or obstructions to fish passage, and acquiring easements or other protective interests for riparian areas. In the estuary, the Action Agencies continue to seek to acquire ownership or development rights to intact patches of habitat and those that are good candidates for restoration. The agencies also continue to implement actions and pursue opportunities to enhance, restore, or create estuary habitats.

Tributary Protection and Improvement

In tributary subbasins, the Action Agencies removed barriers, screened diversions and leased more in-stream flows to provide near-term survival improvements for Snake River spring/summer Chinook, Upper Columbia River spring Chinook, Snake River steelhead, upper Columbia River steelhead and mid-Columbia River steelhead. To provide long-term survival improvements, the Action Agencies protected and enhanced riparian habitat through conservation easements, leases and land acquisitions.

STREAM FLOW IMPROVEMENTS

The Action Agencies, using various mechanisms such as water acquisition agreements and efficiency improvements, increased the water quantity in certain tributaries that provide important spawn-

The Lemhi River Agreement returned instream flows to this stretch of the Lemhi River.

THURLOW TRANSFER DITCH DIVERSION DAM (BEFORE). Looking upstream at the original diversion dam, the ditch is on the left side of Beaver Creek, between the upper Stokes and lower Stokes diversions.

THURLOW TRANSFER DITCH DIVERSION DAM (AFTER). Upstream view of completed weirs. Flows are normal for the season, about 15 cfs.
Photo by Greg Knott, Reclamation, April 2004

ing and rearing habitat for ESA-listed fish. In 2004, the Action Agencies secured almost 90 cubic feet per second (cfs) of additional instream flows. When combined with actions completed in prior years and still maintained, more than 365 cfs of water was delivered to streams in 2004.

Through a cooperative funding agreement with BPA, the National Fish and Wildlife Foundation operates the Columbia Basin Water Transactions Program (CBWTP). The CBWTP supports innovative, voluntary, grassroots water transactions to improve flows to Columbia Basin tributary streams and rivers, working in accordance with state water laws.

In its second full year of operation, the CBWTP completed 25 voluntary transactions around the region, each addressing a significant opportunity to restore instream flows (2004 CBWTP Annual Report Summary, *www.cbwtp.org*). A CBWTP-supported transaction in the Lemhi River is a good example of the benefits of these increased streamflows.

Between the Bitterroot and Lemhi Ranges south of Salmon, Idaho, the Lemhi remains one of the most productive rivers for spring Chinook in the upper Salmon River Basin. While melting snow pack usually provides sufficient flows for adult Chinook returning to spawn, 2004 was a drought year. In response, the Idaho Department of Water Resources, in collaboration with the Office of Species Conservation and Water District 74, negotiated agreements with eight ranchers on a major diversion upstream from the confluence of the Lemhi and Salmon Rivers. The CBWTP paid for water to help maintain minimum stream flows of 35 cfs during the May 16–June 30 migration period. This water transaction augmented spring rains and helped provide needed flows to that stretch of river.

FISH SCREEN IMPROVEMENTS

Installing or retrofitting fish screens at water diversions can prevent or alleviate the entrainment of adult and juvenile fish. Fish screens meeting NOAA Fisheries current specifications have been installed or retrofitted by the Action Agencies at more than 70 locations since the 2000 BiOp was put in place. In 2004, Reclamation removed five barriers and screened four water diversions. These fish screen improvements are reducing fish mortality and providing near-term survival benefits for ESA-listed fish.

IMPROVE FISH PASSAGE

The Action Agencies continued to improve fish passage by removing obstructions that block access to spawning and rearing habitat. These obstructions include water diversions, culverts and other migration barriers. The Action Agencies increased access to high-quality spawning and rearing habitat by supporting projects to remove obstructions and reconnect streams with floodplains and side channels. In 2004, BPA-funded projects helped remove more than 30 barriers or obstructions and opened more than 250 miles of tributary fish habitat. Overall, the Action Agencies' fish passage improvement efforts in the tributaries have resulted in fish regaining access to more than 1,100 miles of stream.

An example of fish passage improvements comes from the Thurlow Transfer Ditch Diversion Dam project. After the Washington Department of Fish and Wildlife identified it as a barrier to fish movement, it was replaced by two rock weirs. The new weirs allow fish passage for all species and life stages, meet diversion flow requirements for the irrigators, and are less noticeable than the original diversion dam. The project is on Beaver Creek, a tributary of the Methow River in Okanogan County, Washington. It is one of a series of voluntary efforts by various Beaver Creek landowners.

Others who contributed to the success of this project include USDA Natural Resources Conservation Service, Okanogan Conservation District, Washington State Salmon Recovery Funding Board and Reclamation. This effort resulted in real on-the-ground habitat improvement for upper Columbia River steelhead and upper Columbia River spring Chinook.

RIPARIAN PROTECTION AND ENHANCEMENT

As a longer-term strategy to improve fish survival, the Action Agencies protect and enhance riparian habitat through various activities. These include acquiring easements or other protective interests in land, treating and fencing riparian areas, and stabilizing stream banks.

In 2004, the Action Agencies funded the protection or enhancement of more than 280 miles of riparian habitat along the tributaries. When added to actions

Habitat improvements in the Columbia River estuary, such as restoration of tidal marsh and forest areas at Crims Island, will provide rearing and foraging habitat for juvenile salmon and other species.

implemented or secured in prior years, almost 1000 miles of riparian habitat is being protected or enhanced due to the efforts of the Action Agencies. Fish survival improvements should begin to accrue and continue in the long-term as a result of these actions.

For example, through the Northwest Power and Conservation Council's (Council) Fish and Wildlife Program, BPA has funded the Longley Meadow Restoration Project in the Grand Ronde subbasin to provide spawning and rearing habitat for steelhead and spring Chinook. The project, carried out by state and federal agencies, a private landowner, and the Confederated Tribes of the Umatilla Indian Reservation, doubled the available riparian habitat in Bear Creek and restored about 15 acres of wetlands. Bear Creek, a tributary stream of the Grand Ronde River in northeast Oregon, was reconnected to its floodplain, allowing annual flooding and enhancing more than 60 acres of wetland.

A new meandering channel was constructed to replace a degraded two-mile stretch of Bear Creek that had been straightened and deepened. The degraded channel created high water velocity and high temperatures during the summer, both unhealthy conditions for salmon and steelhead. The new channel provides slower water velocity flowing over a gravel stream bed where salmon and steelhead can build their redds, or nests. Tree root wads and boulders were also placed at strategic locations to create pools where juvenile fish can shelter and feed. By 2004, tribal crews had planted nearly 50,000 trees and shrubs in Longley Meadow, through which Bear Creek flows.

Estuary Protection and Improvement

In the Columbia River estuary, the Action Agencies continued to fund projects to protect and enhance shallow water habitats. These estuary habitats provide refuge, food and rearing areas for juvenile salmon as they make their transition from freshwater to saltwater. Scientists agree that restoration of the Columbia River estuary is needed to help recover healthy salmon stocks.

These estuary habitat protection and improvement projects are expected to increase survival and reduce predation of juvenile salmon as they prepare to enter the ocean. In 2004, through the Lower Columbia River Estuary Partnership (LCREP) program, 155 acres of habitat were acquired at Germany Creek and the restoration or enhancement of more than 135 acres began at three different sites. Prior to 2004, 451 acres of estuary habitat were acquired at Crims Island and the restoration of almost 800 acres along Grays River and Scappoose Bay began.

Construction work began in late August 2004 at the lower Columbia River's Crims Island on a three-year, $3.8 million habitat restoration project to restore 76 acres of tidal marsh and 115 acres of forest to provide better habitat for young salmon. Tidal marsh restoration will provide juvenile rearing and foraging habitat for fall Chinook, chum and coho salmon. Snake River sockeye, steelhead, coastal cutthroat trout and other species will benefit from restored linkages in the estuarine food web.

The Crims Island project was made possible through a federal-private partnership among the Corps, U.S. Fish and Wildlife Service, BPA, American Rivers, and the Vancouver-based Columbia Land Trust. The project began in August 2003 when the Columbia Land Trust acquired 451 acres on Crims Island with funding assistance from BPA.

Planning began in 2004 on another estuary habitat restoration project in the Sandy River Delta. This project ties in with ongoing US Forest Service habitat work and would restore native hardwood riparian forest and seasonally wet slough as part of a long-term effort to restore 1,500 acres for fish and wildlife habitat.

LONGLEY MEADOWS RIPARIAN ENHANCEMENT (BEFORE) Bear Creek's straightened channel lies in the background. The foreground shows the planned layout for placing the meander back into the creek. *Photos courtesy of Confederated Tribes of the Umatilla Indian Reservation*

LONGLEY MEADOWS RIPARIAN ENHANCEMENT (AFTER) Newly planted grasses take root along Bear Creek's new streamside.

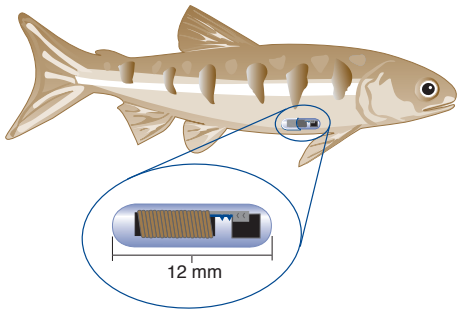
Research, Monitoring & Evaluation

The Action Agencies continue to implement a research, monitoring and evaluation (RM&E) program that focuses on assessing and maximizing performance of hydrosystem and non-hydrosystem actions. The RM&E program was developed and implemented in coordination with the Council's Fish and Wildlife Program, the Corps' Anadromous Fisheries Evaluation Program, Reclamation's appropriated technical assistance activities, and RM&E activities of other agencies.

Status monitoring strategies for collaborative region-wide implementation were developed as part of the Action Agencies' active participation in the Pacific Northwest Aquatic Monitoring Partnership (PNAMP). The Action Agencies continued to monitor the status of listed salmon and steelhead within the hydrosystem corridor and funded pilot status monitoring programs in several Columbia River tributary subbasins and in the estuary. Snake River fall Chinook emergence, growth, migration timing and survival monitoring were continued; the time and accuracy of fish count reporting was improved; and research studies to evaluate juvenile survival, growth, and residence time in the estuary were continued. A comprehensive marking strategy was developed in 2004 to guide the marking of hatchery fish at Action Agency-funded facilities. This strategy enables the monitoring of hatchery-origin fish in natural spawning areas and improves the status assessments of wild fish populations. These programs continue to provide the information needed to determine and track the status of the fish and their environment.

Action effectiveness studies were initiated and continued to assess the effects of actions on fish production, survival, condition and habitat condition in a quantitatively rigorous approach. In 2004, BPA selected and began funding five new studies to determine the relative effectiveness of hatchery fish spawners, taking into account information needs. The Action Agencies also continued to fund pilot studies in the John Day, Wenatchee and Entiat subbasins as well as studies of the cumulative effects of estuary restoration actions on juvenile survival.

Under the John Day subbasin pilot study, Reclamation is funding several research activities to look at the status and trends of ESA listed mid-Columbia steelhead, understand the effectiveness of projects to enhance steelhead habitat, and solve critical uncertainties about steelhead and their habitat. Reclamation has worked with federal, state and tribal biologists to target research activities on the most significant problems limiting steelhead production. Reclamation has teamed up with Oregon State University, Oregon



PIT-tags are used to help monitor fish status.

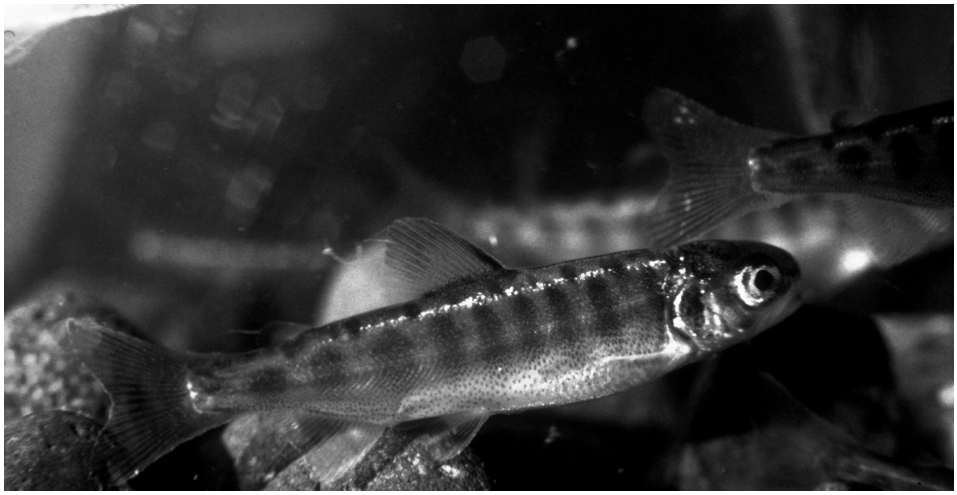
Department of Environmental Quality, and Oregon Department of Fish and Wildlife to study the effects of temperature on steelhead production. These entities have cut costs and improved monitoring significantly by sharing resources.

Reclamation has three projects at the John Day basin scale. Researchers are using satellite imagery for a twenty year period to determine if habitat variables relevant to steelhead production can be evaluated. Reclamation created geo-corrected, low altitude aerial photographs that have been used by multiple agencies in the analysis of habitat conditions and funded a pilot database project that may be used by other researchers.

Reclamation funded critical uncertainty research at the smaller basin scale to understand how steelhead use habitat and how irrigation activities—in particular, the construction of diversion dams—may reduce the production of steelhead. Preliminary results seem to confirm an initial hypothesis that push-up dams could limit steelhead access to cooler habitat. Future work is designed to evaluate push-up dam alternatives that may significantly reduce the effect on production.

The Action Agencies are working with NOAA Fisheries and local entities to identify the most cost-effective habitat enhancement projects to improve steelhead production. In cooperation with PNAMP, Reclamation is identifying intensively monitored watersheds in the John Day basin and will evaluate the effectiveness of various enhancement alternatives.

Critical uncertainties studies continued to address areas of uncertainty in biological assessments of the survival conditions and the needed survival improvements for fish. The Action Agencies continued to monitor and improve the quality of estimates of juvenile migrant survival and adult returns of transported and non-transported fish. Action Agency-funded studies address different dam passage histories on fish survival and health and physically characterize and model the Columbia River plume in the near-shore ocean environment. The Action Agencies also funded development of techniques to evaluate fish survival in the estuary. These studies will contribute to improved analytical methods for population status assessments and survival improvement.



Other Actions

Harvest actions were implemented in 2004 to reduce harvest-related mortality on ESA-listed species. BPA continued to fund the Select Area Fishery Evaluation program to reduce fishing pressure and associated incidental take of listed species in more conventional mixed stock fisheries. The Action Agencies completed the development and testing of tooth-tangle nets for use in the lower Columbia River non-treaty commercial spring fishery. They also continued implementation of NOAA Fisheries' Net Exchange Program and continued to scope the methods and measurements for crediting harvest reforms.

The Action Agencies completed a three-year research study to determine incidental mortality using the tooth-tangle net gear. The Action Agencies also funded the Nez Perce harvest monitoring program and a study to determine the feasibility of locating, marking and removing lost gillnets within the Bonneville and The Dalles reservoirs. These studies contribute to improved harvest management assessments, decisions and evaluations.

Plans for 59 subbasins in the Columbia River Basin were drafted and received public and independent scientific review through a Council-led process in 2004. These plans were developed after nearly two years of work by watershed councils, local governments, and state, federal, and tribal agencies. Twenty-three plans throughout Idaho, Montana, Oregon and Washington were adopted into the Council's Fish and Wildlife Program in December 2004, with the remainder adopted in 2005. Each subbasin plan has an assessment that describes historical and existing conditions, an inventory of existing fish and wildlife projects and past accomplishments, and a management plan that looks ten to 15 years into the future. These plans can be used to form the basis for local recovery plans and will be useful guides for the selection of specific ESA-related projects and actions. Additional information regarding the plans is posted at *www.nwcouncil.org/fw/subbasinplanning/*.

Conclusion

As this report emphasizes, efforts to protect and recover threatened and endangered fish in the Columbia Basin are comprehensive and reflect the complex life cycles of the fish themselves. Progress has been made each year by building on each preceding year's successful effort, and it will take many years to rebuild sustainable populations of some species. Each single recovery component, taken alone, may not produce dramatic results. But taken together, these multiple and carefully coordinated efforts are producing solid and measurable successes.

2005 Preview

It was another drier than normal year in the Columbia River Basin in 2005. The Snake River water supply was as low as 46 percent of average at Lower Granite in March. The water supply at The Dalles Dam was as low as 66 percent of average in March. May and June rainfall boosted the water supply to 63 percent of average at Lower Granite and nearly 76 percent of average at The Dalles. The biological opinion for the FCRPS anticipates that water conditions will fluctuate cyclically and from year to year. River operators fine-tune actions, coordinating through the Technical Management Team. As this chart shows, spring flow objectives were not met in the basin.

injunction granted to plaintiffs in NWF v. NMFS. The agencies were ordered to spill all water in excess of that required for station service at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams on the Lower Snake River from June 20 through August 31, and all flows above 50,000 cubic feet per second at McNary Dam on the Columbia River from July 1 through August 31. The agencies worked with the plaintiffs and others to develop a spill plan that minimized adverse impacts to fish, such as excessive Total Dissolved Gas levels, and provided the best research opportunities to learn from the required operation.

Fig. 4. 2005 seasonal flow objectives and actual flows, in thousand feet per second (kcfs).

	McNary	Lower Granite	Priest Rapids
Spring			
Objective	220	85	135
Actual	196	66	123
Summer			
Objective	200	50	N/A
Actual	TBD	TBD	N/A

In accordance with the biological opinion and Action Agencies' 2004 Updated Proposed Action, in a dry year such as this when the expected flow in the lower Snake River for the spring season is less than 70 kcfs, no spring spill is provided at Lower Granite, Little Goose and Lower Monumental dams on the lower Snake River.

In all years, no spill is called for in the summer at these dams and at McNary Dam on the Columbia River to allow maximum transport of juvenile salmon. However, in early June 2005, the Oregon District Court directed the agencies to provide additional spill for fish as a result of a preliminary

Adult Fish Count

At Bonneville Dam, the combined spring and summer adult Chinook returns were down compared to the exceptional numbers of adult salmon and steelhead returns of 2000–2004. Summer Chinook returns were higher than the ten-year average, but the combined spring and summer counts were lower than the ten-year average. Final counts for the other runs of salmon and steelhead are not yet in.

Fig. 5. Bonneville Dam 2005 Adult Chinook Counts;10-year average = 1995–2004

	Adults		Jacks	
	2005	10-yr average	2005	10-yr average
Spring Chinook	97,397	161,278	5,344	9,966
Summer Chinook	55,029	38,825	3,411	5,798

Additional Resources:

Pacific Coastal Salmon Recovery Fund
www.nwr.noaa.gov/pcsrf/index.htm

Columbia River Inter-Tribal Fish Commission
www.critfc.org

Upper Columbia United Tribes
www.ucut.org

Columbia Basin Fish & Wildlife Authority
www.cbfwa.org

Northwest Power and Conservation Council
www.nwcouncil.org

Oregon Watershed Enhancement Board
www.oregon.gov/OWEB/index.shtml

Washington Salmon Recovery Office
www.governor.wa.gov/gsro/default.htm

Idaho Office of Species Conservation
http://osc.idaho.gov/

Montana Fish, Wildlife and Parks
http://fwp.state.mt.us/default.html

For web site links and more information on federal agency efforts for salmon and steelhead visit *www.salmonrecovery.gov.*